INFORMATION-PROCESSING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an information-processing device provided with a touch panel that permits one to input various kinds of information.

2. Description of the Related Art

The modern liquid-crystal display unit of active matrix type is the most noticeable among display units of all kinds. It finds general use for notebook-size personal computers. Personal computers require high-definition multiple-gradation displays so that they can invoke several kinds of software at one time and accept images from a digital camera.

In addition, there in an increasing demand for liquid-crystal display units of active matrix type which are small in size and yet capable of displaying with high definition, high resolution, and multiple gradation, with the recent spread of portable information terminals, mobile computers, car navigation systems, etc.

These devices are usually designed such that users enter information through other input units than keyboards. In the past, they merely had several switches for information input. However, a touch panel has recently come into use for information input in place of switches.

The conventional touch panel has a sensor of pressure-sensitive type or electrostatic capacity type formed on the entire surface of the panel. When the panel is touched by the tip of a pen or a finger, the sensor detects the position of touch. The touch panel of this structure has the disadvantage of requiring the sensors over the entire surface of the panel, presenting difficulties in production, and posing a problem with mechanical strength.

In order to eliminate the above-mentioned disadvantage, there has been proposed a touch panel of optical type (or photoelectric type) which has light emitting elements and light receiving elements arranged on the opposing sides of the panel. A touch panel of optical type is schematically shown in FIGS. **13**A and **13**B. FIG. **13**A is a front view, and FIG. **13**B is a sectional view taken along the line A–A' in FIG. **13**A.

The panel shown in FIGS. **13**A and **13**B has light emitting elements from **3100***a* to **3100***e* which are linearly arranged on one side of the panel **3000** and also has light receiving elements from **3200***a* to **3200***e* which are linearly arranged on the opposite side of the panel. When the panel is touched by a finger, the ray from the light emitting element **3100***b* is interrupted at the position of touch. The light receiving element **3200***b* opposite to the light emitting element **3100***b* decreases in output signal. In other words, the position where the finger touches the panel is known from the position of the light receiving element which has decreased in output signal.

The disadvantage of the touch penal of optical type shown in FIGS. **13**A and **13**B however is that the ray (travelling through the air) is easily affected by extraneous light and the elements **3100** and **3200** easily get their surface dirty.

A touch panel free of the above-mentioned disadvantage is disclosed in Japanese Patent Laid-Open No. 7-253853. As shown in FIG. **14**, it is composed of a flexible panel **4000** of anisotropic clear crystal and light emitting and receiving elements **4100** and **4200** which are linearly arranged on the opposing sides of the panel. These elements are close to the sides of the panel **4000** and hence less vulnerable to contamination.

The emergent rays from the light-emitting elements **4100** proceed along the optical path (a) and reach the light-receiving elements **4200**. Upon pressing by a finger, the panel **4000** deforms, causing the emergent rays to proceed along the optical path (b). Thus, the emergent rays do not reach the light-receiving elements **4200**, and hence the pressed part is detected. This touch panel is not affected by the extraneous light because it permits the emergent rays to proceed in the panel.

The above-mentioned touch panel (shown in FIG. **14**) has the disadvantage that the panel **4000** deforms to affect the liquid crystal panel thereunder, with the cell gap varied. In addition, the pressed and deformed part may diffuse light in the panel **4000** instead of deflecting the optical path (b) outward if it has an inadequate radius of curvature. Diffused light prevents the detection of accurate positions.

Conventional touch panels have many problems and are unsatisfactory as mentioned above.

The touch panel as information input means for portable information terminals and car navigation systems is usually provided with a liquid-crystal display unit of active matrix type, as mentioned above. Unfortunately, it has the disadvantage of causing failures in data entry or point selection, because the conventional liquid-crystal display unit of active matrix type forms a color image from red, green, and blue pixels.

SUMMARY OF THE INVENTION

The present invention was completed to tackle the above-mentioned problems. It is an object of the present invention to provide a information-processing device, such as a portable information terminal, which is provided with a touch panel resistant to extraneous light, contamination, and mechanical shocks and capable of accurate information input and also with a fine liquid-crystal display unit.

The information-processing device according to the present invention comprises a field sequential display unit and a touch panel, said sequential display unit having a back light to supply three-color light and an image display part which forms an image for one frame by the sequential time-sharing display of three subframes corresponding to said three-color light, and said touch panel having an optical guide plate of transparent material, an optical sensor array whose light receiving surface is opposite to the side of said optical guide plate, a lens sheet whose light emitting surface is opposite to that side of said optical guide plate which is opposite to said side, and an illuminating means to illuminate the plane of incidence of said lens sheet.

Said three-color light may be supplied from a red LED, a green LED, and a blue LED.

Said transparent material may be one which has a refractive index of 1.4–1.7.

The plane of incidence of said lens sheet may have a plurality of prismatic or semicylindrical projections.

Said illuminating means may have an LED.

Said touch panel may have an input pen with which to touch the surface of said optical guide plate, and that part of said optical guide plate with which said input pen comes into contact may be formed from a transparent material which has a refractive index equal to or higher than that of the transparent material forming said optical guide plate.

Said touch panel may have an input pen with which to touch the surface of said optical guide plate, and the tip of said input pen is formed from a material which absorbs the illuminating light from said illuminating means.